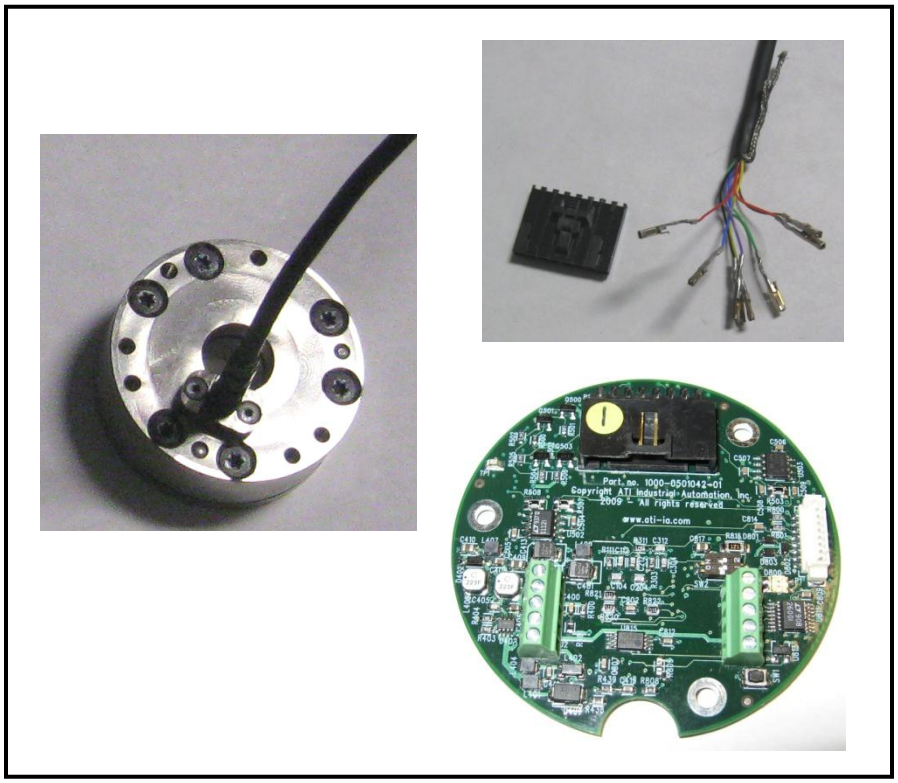
F/T CAN Bus and Serial Bus Network Interface for OEM

Installation and Operation Manual



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Note

Please read the manual before calling customer service. Before calling, have the following information available:

1. Serial number (e.g., FT01234)
2. Transducer model (e.g., Nano17, Gamma, Theta, etc.)
3. Calibration (e.g., US-15-50, SI-65-6, etc.)
4. Accurate and complete description of the question or problem
5. Computer and software information. Operating system, PC type, drivers, application software, and other relevant information about your configuration.

If possible, be near the F/T system when calling.

How to Reach Us

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Glossary

Terms	Definitions
CAN	Controller Area Network (CAN) is a low level, message based communication protocol.
E-Exit	ATI's E-Exit transducers have a cable with an over-molded strain relief.
F/T	Force/Torque.
F/T Transducer	Converts force and torque into an electrical signal.
MAP	The Mounting Adapter Plate (MAP) is the transducer plate that attaches to the fixed surface or robot arm.
MOLEX SL	Product series from the connector manufacturer Molex.
Net Box	The component that contains the power supply and network interfaces of the Net F/T system. It can alternatively be used to interface with the NETCANOEM.
STG	Strain Gage
TAP	Tool Adapter Plate (TAP) is the transducer surface that attaches to the load to be measured.
Transducer	Transducer is the component that converts the sensed load into electrical signals.

1. Safety

The safety section describes general safety guidelines to be followed with this product, explanation of the notification found in this manual, and safety precaution that apply to the product. More specific notification are embedded within the sections of the manual where they apply.

1.1 General

The customer should verify that the transducer selected is rated for maximum loads and moments expected during operation. Refer to F/T Transducer Manual (*9620-05-Transducer Section—Installation and Operation Manual*) found in Net F/T Installation and Operation Manual (*9610-05-1022*) or contact ATI Industrial Automation for assistance. Particular attention should be paid to dynamic loads caused by robot acceleration and deceleration. These forces can be many times the value of static forces in high acceleration or deceleration situations.

1.2 Explanation of Notifications

The notifications included here are specific to the product(s) covered by this manual. It is expected that the user heed all notifications from the robot manufacturer and/or the manufacturers of other components used in the installation.

DANGER: Notification of information or instructions that if not followed will result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

WARNING: Notification of information or instructions that if not followed could result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

CAUTION: Notification of information or instructions that if not followed could result in moderate injury or will cause damage to equipment. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

ATTENTION, NOTE, or NOTICE: Notification of specific information or instructions about maintaining, operating, installation, or setup of the product that if not followed could result in damage to equipment. The notification can emphasize but is not limited to specific setting values, good operating practices, or maintenance tips.

1.3 Safety Precautions

CAUTION: Do not remove any fasteners or disassemble transducers without a removable mounting adapter plate. These include Nano, Mini, IP-rated, and some Omega transducers. This will cause irreparable damage to the transducer and **void the warranty**. Leave all fasteners in place and do not disassemble the transducer.

CAUTION: Do not probe any openings in the transducer. This will damage the instrumentation.

CAUTION: Do not exert excessive force on the transducer. The transducer is a sensitive instrument and can be damaged by applying force exceeding the single-axis overload values of the transducer and cause irreparable damage. Small Nano and Mini transducers can easily be overloaded during installation. Refer to the F/T Transducer manual (9620-05-Transducer Section) for specific transducer overload values.

2. Overview

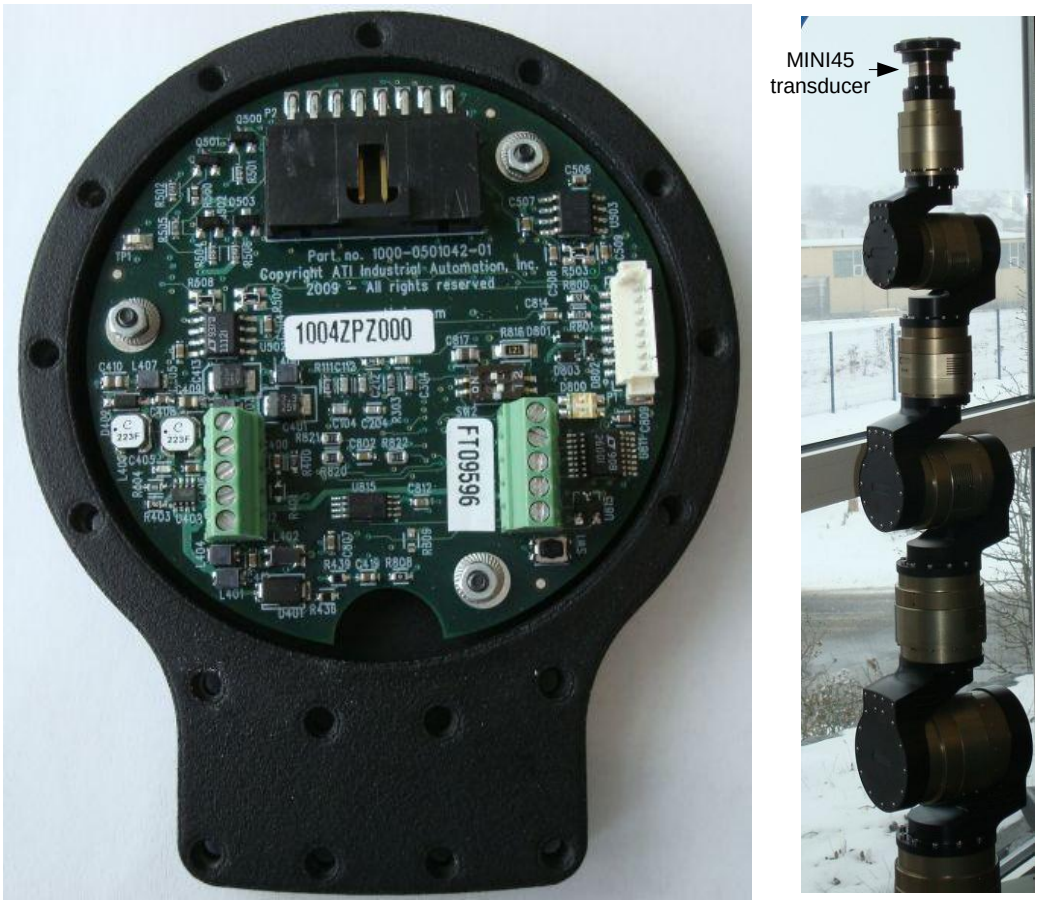
The F/T CAN and Serial Bus Interface Sensor System consists of an ATI transducer and a F/T-to-CAN interface board (NETCANOEM). The transducer selected will include a Molex SL connector (MSL). In order to allow easy routing of the transducer cables through tight spaces, the transducer is shipped without a connector housing. Connector contacts are crimped to the eight wires of the transducer cable. After the cable routing is completed, the contacts can be inserted in a connector housing which can then be plugged into the NETCANOEM interface board.

An adapter cable can also be purchased to allow a NETCANOEM interface with the 12-Pin Amphenol connector, standard on ATI Nano and Mini Transducers. Refer to *Section 9.6—Available tools, Adapters, and Spare Parts* for a list of optional part numbers. The transducer can also be ordered with the MSL connector already attached, this is the –ZC option.

The interface board is designed to be mounted within a customer's enclosure and gets supplied by customer provided 24VDC power supply. It connects to the control electronics via CAN bus or RS485 interface. Power and bus signals are connected to the board via screw terminals.

Figure 2.1 shows sample application using the NETCANOEM mounted in a segment of a light weight arm and a Mini45 transducer mounted on the arm.

Figure 2.1—Sample Application



3. Compatible Transducer

Transducers with part numbers ending in MSL are custom designed for use with NETCANOEM. It differs from a standard Nano or Mini transducers in the following features:

- MOLEX SL connector contacts crimped to the eight wires of the transducer cable
- Shipped with connector housing as a separate item to allow for cable routing through the center of the robotic arm.
- Available with –E and –AE exit transducers (strain-relieved).

Figure 3.1—Transducer with Stain Relieved Cable

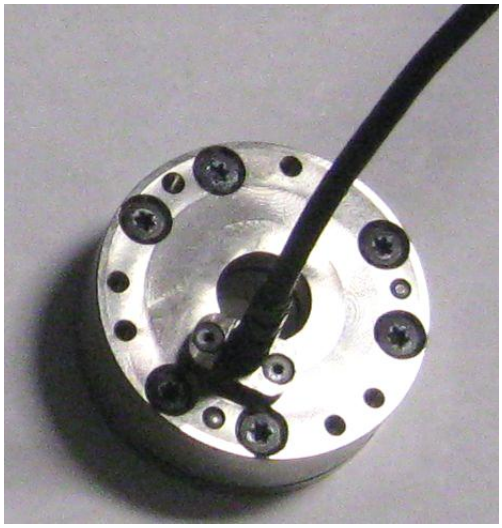
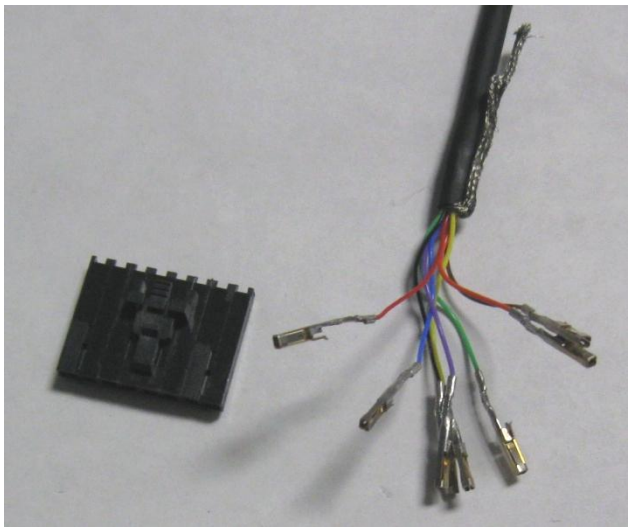


Figure 3.2—MSL Transducer Cable

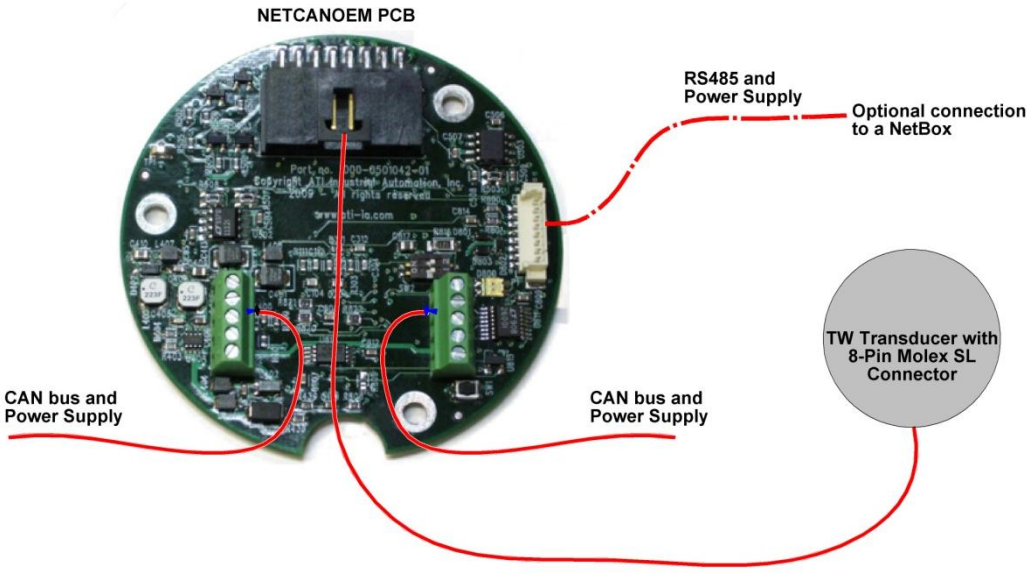


A transducer is available with the –ZC8 option, designating an MSL connector installed at the factory

4. NETCANOEM F/T Interface Board

The NETCANOEM provides a CAN bus interface for ATI's TW transducers. Equipped with an 8-pin MOLEX SL connector (like the 9105-TW-MINI45TH12-AE-0.40-MSL), they can be plugged directly into the NETCANOEM PCB.

Figure 4.1—NETCANOEM System


NETCANOEM PCB
RS485 and Power Supply
Optional connection to a NetBox
TW Transducer with 8-Pin Molex SL Connector
CAN bus and Power Supply
CAN bus and Power Supply

The 9105-NETCANOEM interfaces with the transducer's strain gages via connector P2. The strain gage signals get digitized with a 16bit A/D converter and are then transmitted over a CAN bus interface.

Up to 16 transducer calibrations can be stored in the on-board EEPROM.

If the NETCANOEM is connected to a NetBox via P1, the digitized data are also sent over a high-speed RS485 interface to the NetBox where they get converted to force and torque values. The F/T values can then be accessed via Ethernet.

The NETCANOEM can be supplied with a DC voltage between 12V and 24V DC.

Figure 4.2—NETCANOEM Block Diagram

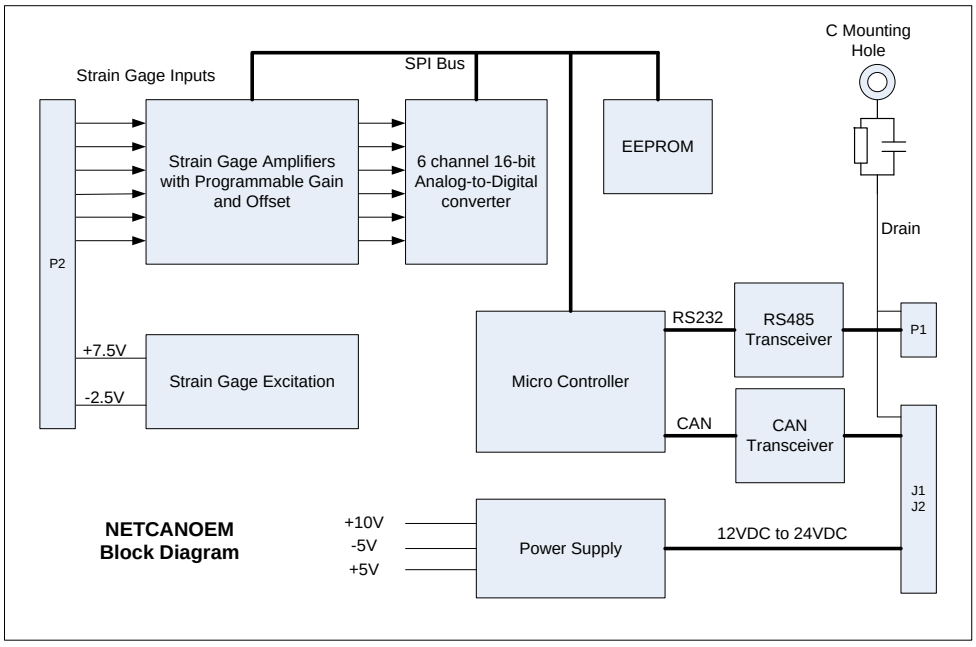


Figure 4.3— NETCANOEM – Top View

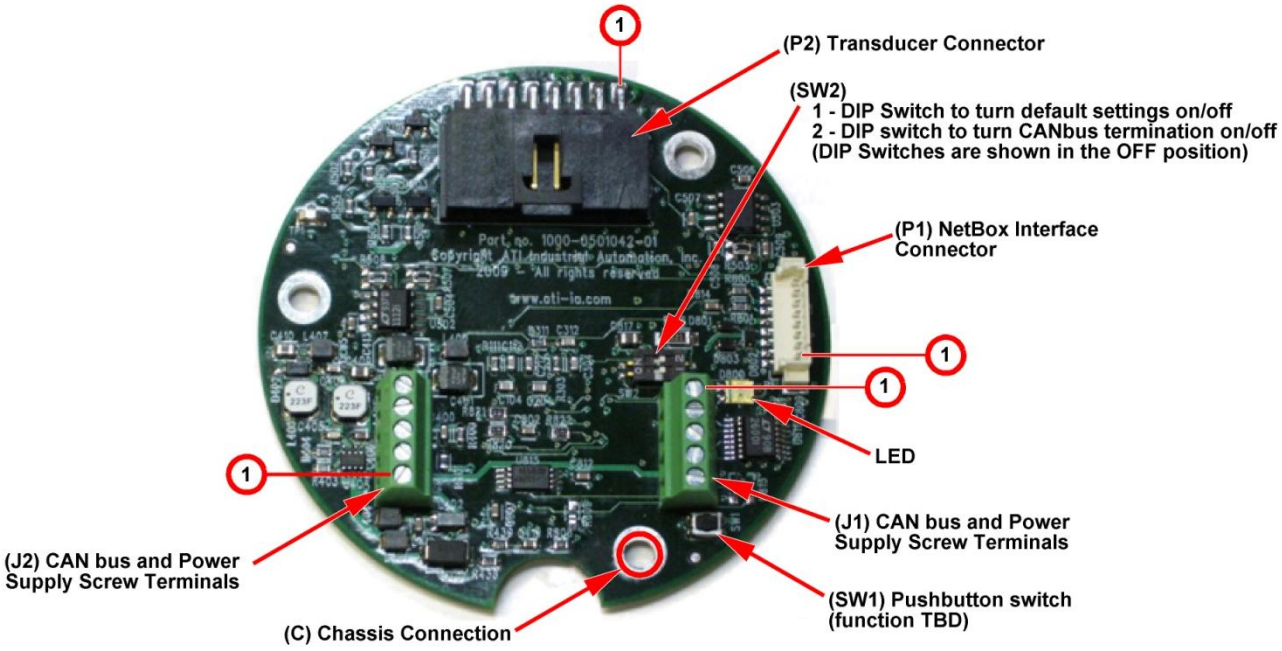
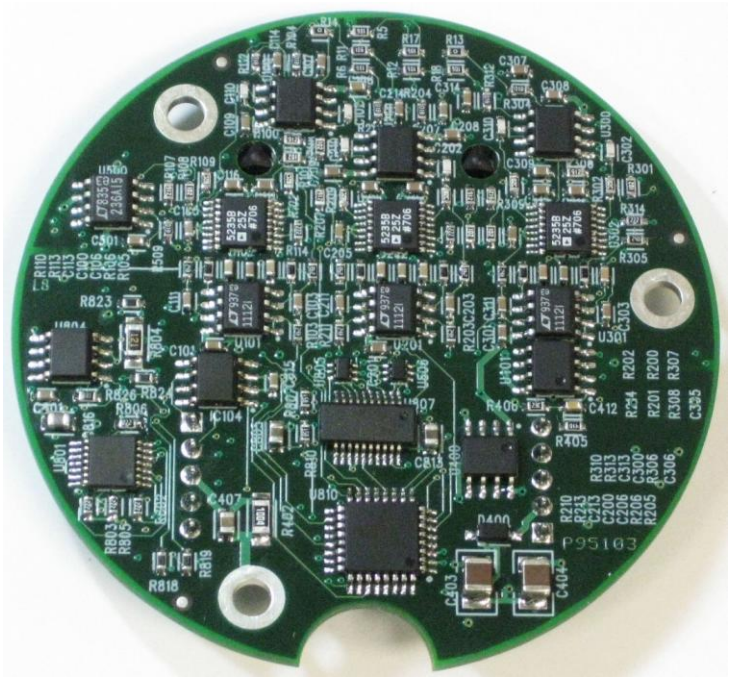

1
(P2) Transducer Connector
(SW2)
1 - DIP Switch to turn default settings on/off
2 - DIP switch to turn CANbus termination on/off
(DIP Switches are shown in the OFF position)
(P1) NetBox Interface Connector
1
1
LED
1
(J1) CAN bus and Power Supply Screw Terminals
(J2) CAN bus and Power Supply Screw Terminals
(SW1) Pushbutton switch (function TBD)
(C) Chassis Connection

Figure 4.4—NETCANOEM – Bottom View



4.1 Connectors

The following connectors are available on the Analog to CAN PCB Assembly:

4.1.1 P1 Connector for NetBox Interface

Mating connector housing: Molex 51021-0800

Mating connector contact: Molex 50058-8000

Pin No.	Signal Name	Description
1	SL_GND	Power Supply Ground
2	RS485-	- Serial Interface to NetBox
3	DRAIN	Serial Interface Shield
4	RS485+	+ Serial Interface to NetBox
5	SL_VP	Power Supply Positive
6	RESET	Programmer Reset
7	BKGD	Programmer Background Debug
8	DGND	Programmer Digital Ground

4.1.2 P2 Connector for Transducer Strain Gages

Mating connector housing: Molex 50-57-9408

Mating connector contact: Molex 16-02-0101

Pin No.	Signal Name	Description
1	+VSG	Positive strain gage bridge supply voltage
2	-VSG	Negative strain gage bridge supply voltage
3	G0	Strain gage 0 voltage
4	G1	Strain gage 1 voltage
5	G2	Strain gage 2 voltage
6	G3	Strain gage 3 voltage
7	G4	Strain gage 4 voltage
8	G5	Strain gage 5 voltage

4.1.4 J1 Screw Terminal

5-pin Combicon MPT Screw Terminal / Phoenix Contact 1725685

Maximum load current: 6A

Conductor cross-section min.: 0.14 mm^2

Conductor cross-section max.: 0.5 mm^2

Pin No.	Signal Name	Description
1	CAN_L	- CAN BUS
2	CAN_H	+ CAN BUS
3	DRAIN	Serial Interface Shield
4	SL_VP	Power Supply Positive
5	SL_GND	Power Supply Ground

4.1.5 J2 Screw Terminal

5-pin Combicon MPT Screw Terminal / Phoenix Contact 1725685
Maximum load current: 6A
Conductor cross-section min.: 0.14 mm^2
Conductor cross-section max.: 0.5 mm^2

Pin No.	Signal Name	Description
1	SL_GND	Power Supply Ground
2	SL_VP	Power Supply Positive
3	DRAIN	Serial Interface Shield
4	CAN_H	+ CAN BUS
5	CAN_L	- CAN BUS

4.2 Switches

The following switches are available on the Analog to CAN PCB Assembly:

4.2.1 SW1

This push-button switch is currently unused.

4.2.2 SW2

The two-position DIP switch has the following functions:

Position	ON/OFF	Description
1	ON	Default settings ON
	OFF	Default settings OFF
2	ON	CAN bus termination activated
	OFF	No CAN bus termination active

4.3 LEDs

One dual-color LED signals the status of the NETCANOEM in the following way:

LED State	Description
Off	No power
Green	Correct CAN operation
Flashing Green	Default settings
Red	CAN bus error (bit 14 in the status register is set)[1]
Flashing Red	bit 15 in the status register is set
Amber	reserved
Flashing Amber	reserved

[1] See Section 5.3 for details

5. CAN Bus Interface

The CAN bus interface allows a user to:

- Determine which calibration is active
- Select a calibration to be active
- Read the active calibration matrix
- Select the CAN baud rate (up to 2Mbps)
- Select the base identifier (upper 7 bit of the 11bit identifier)
- Reset the NETCANOEM
- Read the firmware revision of the NETCANOEM
- Read FT calibration serial number
- Request strain gage data and status information.

An on-board 120 Ohm termination resistor can be turned on/off via DIP switch SW2, position 2.

Default settings:

Setting DIP switch SW2, position 1 into the on-position will set the CAN bus interface to its default settings, which will become active after a reset command or power-cycle:

Baud rate = 250kbps,

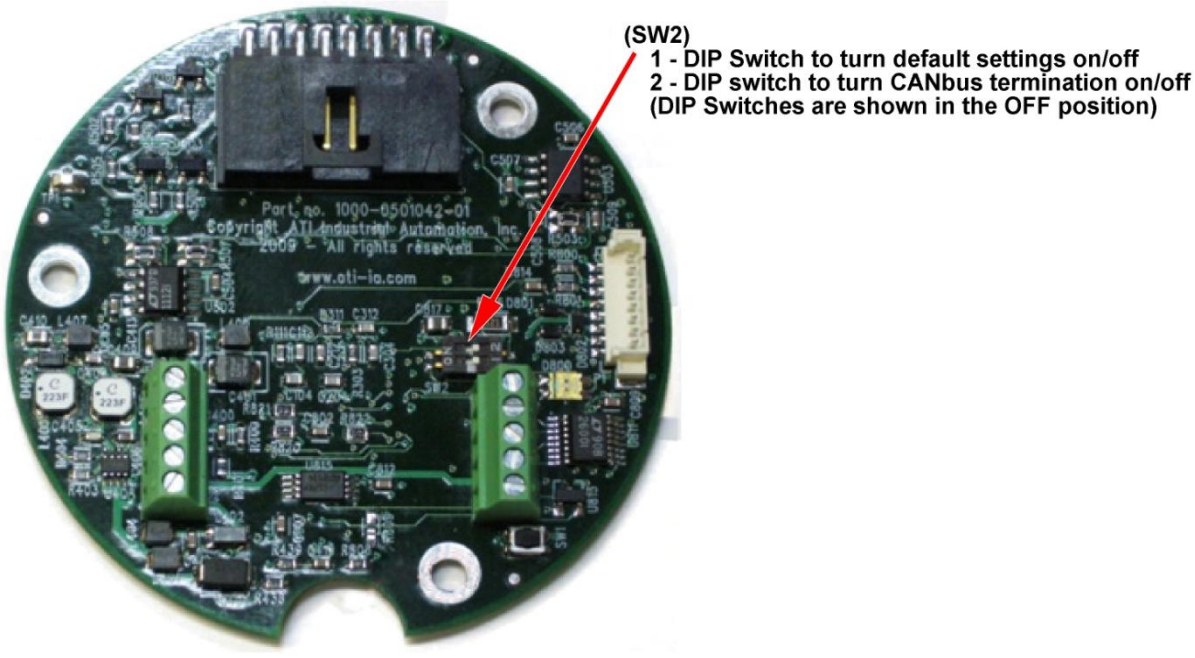
Base identifier = 20 HEX

5.1 Reset Default Settings

If experiencing issues communicating with the NETCANOEM board, reset the board to the default settings:

1. Remove power from NETCANOEM board.
2. Remove cover to access NETCANOEM board.
3. Set DIP switch SW2 position 1 to the ON position. Refer to *Figure 5.1*.
4. Replace cover and apply power to the NETCANOEM board.
5. Test communication with board. If no communication with the NETCANOEM board is possible using default settings, contact ATI Industrial Automation Customer Service.

Figure 5.1— NETCANOEM – SW2 DIP Switch


(SW2)
1 - DIP Switch to turn default settings on/off
2 - DIP switch to turn CANbus termination on/off
(DIP Switches are shown in the OFF position)

5.2 CAN Interface Opcodes

The Opcode is transmitted as the last 4 bits of the message identifier. The first 7 bits of the CAN identifier are the software configurable "Base Identifier".

All data are in big-endian format (network order).

Table 5.1**—CAN Interface Opcodes**

Code	Function	Data	Response
b0000 or 0x0	Read SG Data	None	Two response packets are sent: One with the opcode set to b0000, which contains the two byte status code, followed by the two byte values for sg0, sg2, and sg4 (total of eight bytes), and another packet with the opcode b0001, which contains the three two byte values sg1, sg3, and sg5 (total of six bytes). It will be necessary to reorder the strain gauges to the order (sg0, sg1, sg2, sg3, sg4, sg5) before performing the matrix multiplication. Alternatively, you can rearrange the order of the columns in the matrix to match the (sg0, sg2, sg4, sg1, sg3, sg5) ordering in this response.
b0010 or 0x2	Read Matrix	1 byte indicating axis row to read (0=Fx, 1=Fy, 2=Fz, 3=Tx, 4=Ty, 5=Tz)	Three response packets (8 bytes each) are sent. All matrix coefficients are in 4 byte floating point format: Opcode b0010 containing the SG0 and SG1 coefficients for the requested axis. Opcode b0011 containing the SG2 and SG3 coefficients. Opcode b0100 containing the SG4 and SG5 coefficients.
b0101 or 0x5	Read F/T Serial Number	None	One response packet with the opcode b0101, with 8 data bytes which contain an ASCII string representing the F/T serial number
b0110 or 0x6	Set Active Calibration	1 byte indicating index of calibration to use Possible index values are 0 to 15	One response packet with opcode b0110 with one data byte echoing the selected calibration index.
b0111 or 0x7	Read Counts Per Unit[2]	None	One response packet with opcode b0111, with 8 bytes of data. The first 4 bytes are the counts per force, followed by the 4 byte counts per torque. Both count values are integers.
b1000 or 0x8	Read Unit Codes[2]	None	One response packet with the opcode b1000, with two bytes of data. The first byte is the force unit code: Force unit — Force Unit Code lbf — 1 N — 2 Klbf — 3 kN — 4 kgf — 5 gf — 6 The second byte is the torque unit code:

[2] This function is only available with firmware revision 3.7 or higher

<table>
<tr><th colspan="4">Table 5.1—CAN Interface Opcodes</th></tr>
<tr><td></td><td></td><td></td><td>Torque Unit Torque Code
lbf-in1
lbf-ft2
N-m3
N-mm4
kgf-cm5
kN-m6</td></tr>
<tr><td>Bb1001
Or
0x9</td><td>Read Diagnostic ADC Voltages[3]</td><td>One byte containing the index of the diagnostic value to read:<table><tr><th>Index</th><th>Diagnostic</th></tr><tr><td>0</td><td>MID_VSG</td></tr><tr><td>1</td><td>Unused</td></tr><tr><td>2</td><td>Thermistor</td></tr><tr><td>3</td><td>Power</td></tr><tr><td>4</td><td>DAC</td></tr><tr><td>5</td><td>Ground</td></tr></table></td><td>One response packet with opcode b1001 and two bytes of data which contain the requested diagnostic ADC reading.</td></tr>
<tr><td>b1100
or
0xC</td><td>Reset</td><td>None</td><td>None</td></tr>
<tr><td>b1101
or
0xD</td><td>Set base identifier (first 7 bits)</td><td>1 byte indicating the first 7 bits to use. The 7 bits are right-justified in the data byte.</td><td>One response packet with opcode b1101 with no data. The command will take effect at the next powerup.</td></tr>
<tr><td>b1110
or
0xE</td><td>Set baud rate</td><td>1 byte indicating the divisor code used to set the baud rate. A base rate of 2 mbps is divided by this value + 1 to generate the effective baud rate.

E,g, value=3 → divisor=4
→ baud rate = 500kbps</td><td>One response packet with opcode b1110 with no data. The command will take effect at the next powerup.</td></tr>
<tr><td>b1111
or
0xF</td><td>Read Firmware version</td><td>None</td><td>One response packet with opcode b1111 with 4 bytes of data. The first byte is the major version, the second byte is the minor version, and the next two bytes are the build number.</td></tr>
</table>

Example: To read the strain gage data from a NETCANOEM with "base identifier" 0x20, you have to add the op code b0000 (b stands for binary) which results in the identifier 0x200 (0x stands for HEX). In a similar way, you add the op code b1100 (= 0xC) which results in the identifier 0x20C in order to reset the NETCANOEM.

[3] Only available in firmware versions 3.8.x and higher.

5.3 NETCANOEM Status

The NETCANOEM periodically performs several diagnostic checks to determine if the strain gage measurement data are valid. The diagnostic status is transmitted with each data sample. In case of a critical error (see *Table 5.2*), the NETCANOEM will not stop transmitting strain gage data. It is the responsibility of the receiving application to handle critical errors appropriately.

Table 5.2**— NETCANOEM Status Register**

Bit	Name	Type	Remark / Recommended error handling
0	Watchdog Reset		Can occur after firmware-upgrade; replace NETCANOEM if this happens during normal operation
1	DAC/ADC check result too high	Critical	Analog Acquisition system gets checked once after reset Stop operation - replace NETCANOEM
2	DAC/ADC check result too low	Critical	Analog Acquisition system gets checked once after reset Stop operation - replace NETCANOEM
3	Artificial analog ground out of range	Critical	Stop operation - replace NETCANOEM
4	Power supply too high	Critical	Stop operation – check power supply to NETCANOEM
5	Power supply too low	Critical	Stop operation – check power supply to NETCANOEM
6	Bad active calibration	Critical	Select a valid calibration slot. Checksum of the selected calibration is wrong.
7	EEPROM failure	Critical	Stop operation - No or invalid EEPROM response; Checksum error in EEPROM memory, replace NETCANOEM if this happens during normal operation
8	Configuration Invalid		Checksum error in stored configuration data; NETCANOEM will use default settings
9	Reserved		
10	Reserved		
11	Sensor temperature too high	Critical	Stop operation - Make sure that ambient temperature of the NETCANOEM stays within the specified range (see Table 10.1 for details)
12	Sensor temperature too low	Critical	Stop operation - Make sure that ambient temperature of the NETCANOEM stays within the specified range (see Table 10.1 for details)
13	Reserved		
14	CAN bus error		CAN bus error detected; turns status LED to red
15	Any error causes this bit to turn on		

6. NetBox Interface

The NETCANOEM can alternatively be connected to a NetBox (9105-NETB) via connector P1. It will then behave like a Net Analog Board. Please refer to the Net F/T manual for a description of the available functions: http://www.ati-ia.com/app_content/documents/9610-05-1022.pdf

Note: It is not recommended to operate the NETCANOEM with CAN bus and NetBox interface at the same time. In this case, the response time of the CAN interface can become unpredictable. Also, settings performed by one interface can be overwritten by the other interface without warning.

6.1 Firmware Upgrade

The firmware of the NETCANOEM can be upgraded by using the firmware upgrade utility for Net F/T systems. Please contact ATI if this becomes necessary.

6.2 Debug

If communication over CAN bus is not possible, the NetBox interface can be used to read the NETCANOEM status register.

7. Net Digital Interface (Optional)

Instead of using a NetBox one can also directly connect to the RS485 interface with a high speed xxx interface. See details in the NET-Digital user manual

8. STG Data Acquisition and Matrix Calculation

8.1 Preparations

After a reset or power-cycle, the following steps have to be performed before a data acquisition can begin:

1. Select the correct calibration. With the "Set Active Calibration" command a calibration-slot number between 0 and 15 is sent to the NETCANOEM. If the transducer has several calibrations (up to 16 are possible), then the calibration-slot will be set to the new number. If there is no valid calibration in the selected slot, then bit 6 "Bad active calibration" in the status register will be on.
2. Verify that the correct calibration is selected: The "Set Active Calibration" command echoes the selected calibration slot. Verify that it matches the desired calibration slot number.
3. Read the active calibration matrix with the "Read Active Calibration" command.
4. Read the Counts per Force and Counts per Torque values (this is only available since firmware versions 3.7 and later – with older firmware use 1000000 for both values).

After the above steps are completed, strain gage data can be requested as often as desired until a reset or power cycle.

Note: The NETCANOEM does not store the active calibration setting in its nonvolatile memory. It will always default to calibration-slot 0 after reset. This allows for indefinite calibration changes without using up the limited amount of write cycles of the EEPROM memory. A transducer with multiple calibrations can, for example, be used with a coarse and a fine measurement range. In this case, frequent calibration changes may be required.

8.2 Request Strain Gage Data

The "Read SG Data" command returns the six 16-bit strain gage values and a 16-bit status code.

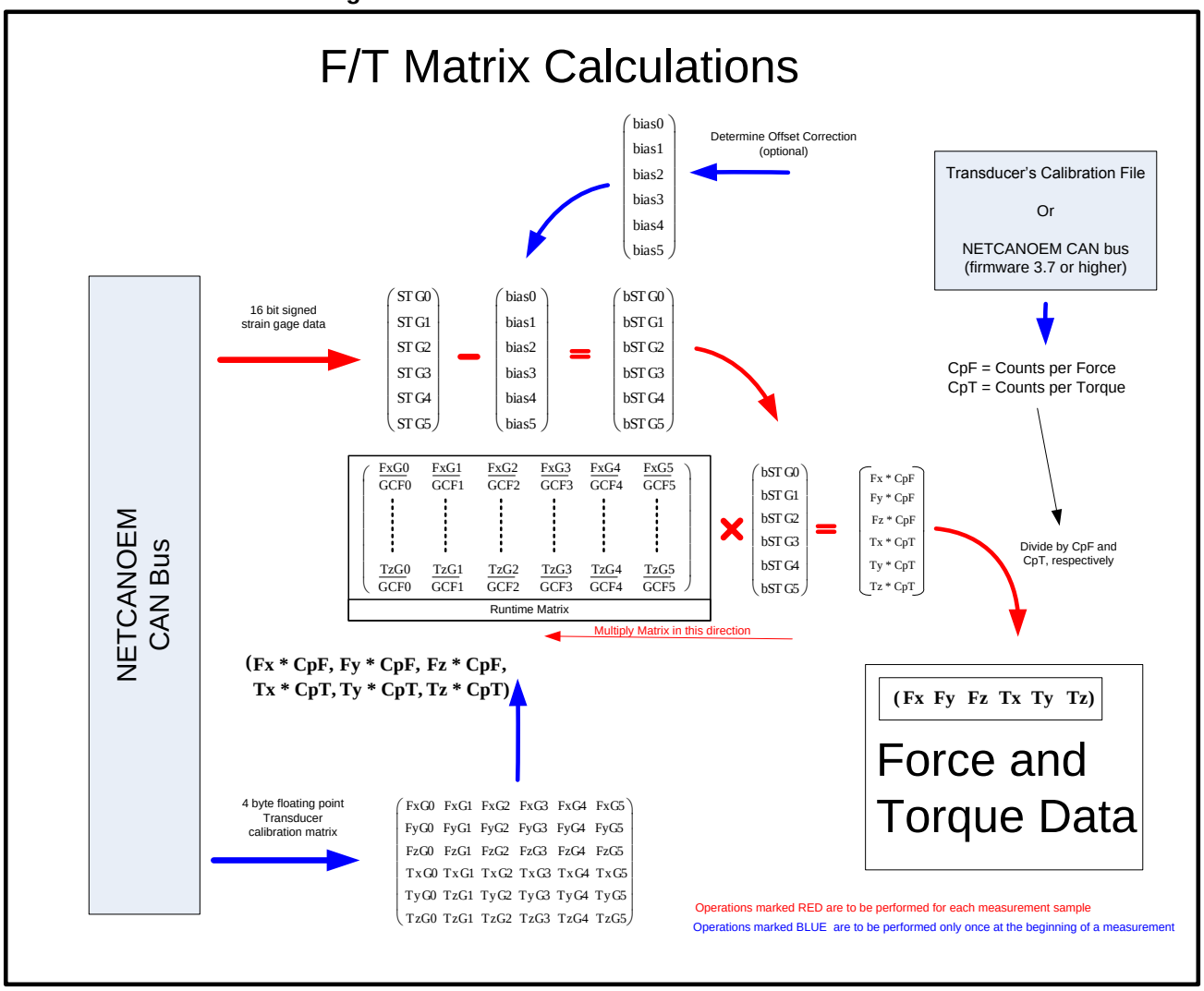
In order to compensate the transducers offset errors, it is recommended to establish a bias vector as often as possible.

8.3 Calculating Force and Torque Data

To obtain force and torque data the strain gage values (signed 16 bit format) have to be multiplied with the calibration matrix (4 byte floating point format) of the transducer. *Figure 7.1* illustrates the generic F/T matrix calculation procedure. The result of the matrix multiplication has to be divided by the Counts per Force (CpF) and Counts per Torque (CpT), respectively. CpF and CpT values can be obtained from the transducer's calibration file and with NETCANOEM firmware revision 3.7 and higher also over the CAN interface. For any MINI45 calibration the value of CpF and CpT is 1000000.

Instead of dividing the result of the matrix calculation one can also divide the matrix values by the CpF and CpT values. This may save computing time since it would only have to be done once at the beginning of the measurement and not with every sample during the measurement phase.

Figure 7.1— Generic F/T Matrix Calculation Procedure



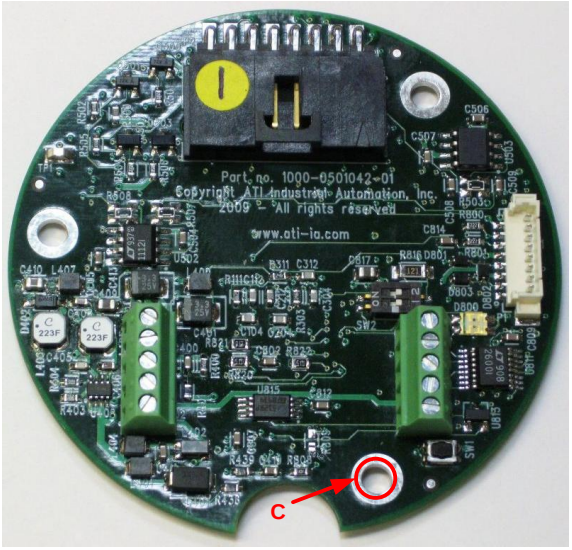
ATTENTION: When one of the strain gage data reads the positive or negative maximum (nominally -32768 or +32767), that gage is saturated. This can, for example, be caused by a broken transducer cable. In this case, the sensor data is not usable anymore. It is the responsibility of the receiving application to handle this error situation appropriately (e.g., request maintenance).

9. Hardware Installation

9.1 PCB Mounting

The NETCANOEM provides three mounting holes. One of these (marked “C” in the picture below) provides a path to the drain connection of the CAN bus and the RS485 cable. For best EMI performance, “C” should get connected to chassis ground.

Figure 8.1—PCB Mounting



To minimize PCB vibration, all three mounting holes should be used.

9.2 Transducer Connector Assembly

A Nano or Mini -MSL transducer is shipped with its crimp contacts not inserted in the connector housing. This will allow feeding the transducer cable through a robot arm or other tight spaces.

Please follow the directions given in *Section 12.2—Insertion and Extractor Tool for Transducer Connector Contacts* to insert the contacts into the connector housing. Insert the crimp contacts according to *Figure 8.2*.

Figure 8.2—Cable color assignment

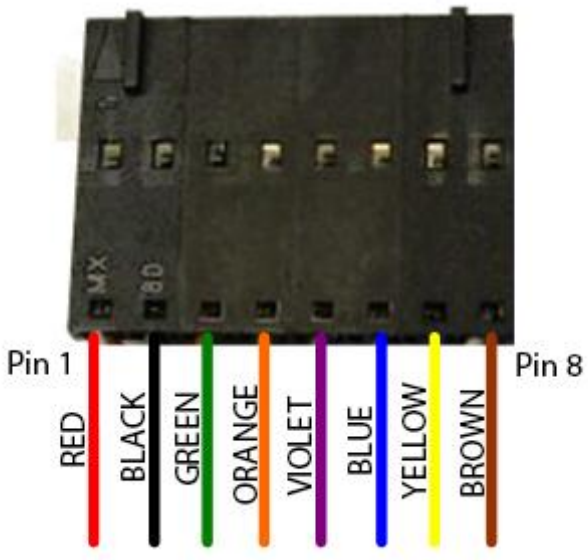
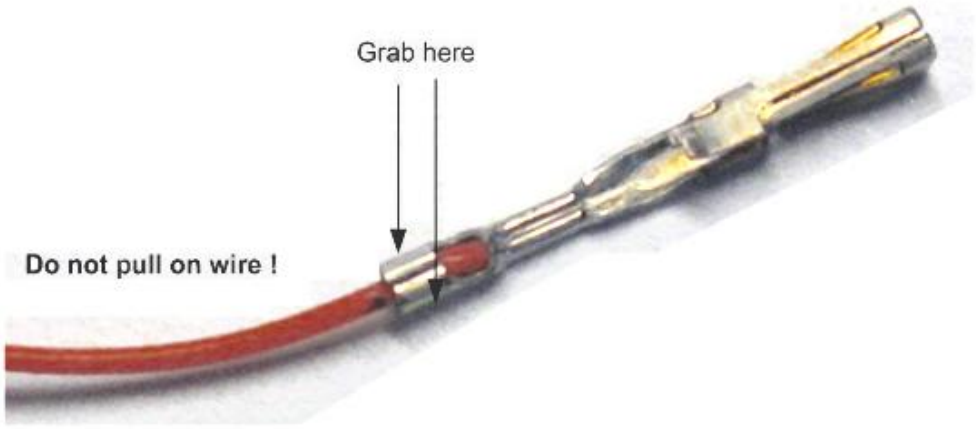


Table 8.1**—Transducer Connector Pin Assignments**		
Color	**Signal**	**Pin #**
Red	+V	1
Black	-V	2
Green	SG0	3
Orange	SG1	4
Violet	SG2	5
Blue	SG3	6
Yellow	SG4	7
Brown	SG5	8

Note: Due to the thin transducer wires (AWG 36), the connection between crimp contact and wire is very delicate (about 0.5 lbs max. pull strength). Care has to be taken when handling these contacts. Don't pull on the wires; instead grab the contact at its end.

Figure 8.3—Crimp Connection



9.3 Transducer Handling

In addition to the standard transducer handling instructions (see Manual *9620-05-Transducer Section* for details), the following should be observed:

- The transducer calibration label FTxxxx must not be removed or painted over. If a transducer gets returned to ATI for calibration or repair, it is important that this number is present.
- The transducer connector has no strain relief. To protect the fragile crimp contacts it is important to provide a suitable strain relief in the final product.

9.4 Ground and cable shield considerations

There are several options for connecting the transducer cable shield:

1. If the transducer is connected to chassis ground, then don't connect the cable shield (since the shield is connected to the transducer body and such to chassis ground).
2. If the transducer is isolated, then:
    a) Connect the cable shield to chassis ground or
    b) Connect the cable shield to the Drain connection on the board (J1/3) or
    c) Connect the cable shield to power ground (J1/5).

You may have to experiment to find the best solution for EMC compliance and best noise performance.

9.5 Power Supply Considerations

The NETCANOEM can be supplied with a DC voltage between 12V to 24V. To achieve lowest noise on the strain gage data it is recommended to keep the power supply ripple as low as possible.

9.6 Available tools, Adapters, and Spare Parts

To support system assembly and debug ATI can supply the following:

- Molex SL contact insertion tool to help with the correct transducer connector assembly (ATI part no. 3805-05-1115)
- Molex SL crimp hand tool (ATI part no. 3805-05-1114)
- Molex SL crimp contact for AWG 32-36 (ATI part no. 1705-0610206-02)
- Molex SL 8-pin contact housing (ATI part no. 1540-2112001-08)
- NetBox interface adapter cable (ATI part no. 9700-0500004-03)
- Amphenol connector to Molex SL adapter cable(ATI Part no 9105-C-A-MSL-0.15)

Figure 8.4—Tools and Adapters

Molex SL Contact Insertion Tool
ATI part no. 3805-05-1114
NetBox Interface Adapter Cable
ATI part no. 9700-0500004-03
Molex SL Contact Housings
ATI part no. 1540-2112001-08

10. Troubleshooting

10.1 Introduction

This section includes answers to some issues that might arise when setting up and using the NETCANOEM system. The question or problem is listed followed by its probable answer or solution. They are categorized for easy reference.

The information in this section should answer many questions that might arise in the field. Customer service is available to users who have problems or questions addressed in the manuals.

ATI Industrial Automation
Attn: F/T Customer Service
Pinnacle Park
1031 Goodworth Drive
Apex, NC 27539 USA

Phone: +1.919.772.0115
Fax: +1.919.772.8259
Email: ft_support@ati-ia.com

Note:

Please read the F/T manuals before calling customer service. When calling, have the following information available:

1. Serial number(s)
2. Transducer type (e.g., Nano17, Gamma, Theta)
3. Calibration (e.g., US-15-50, SI-130-10)
4. An accurate and complete description of the question or problem.
5. If possible all information that is displayed on Net F/T page *System Info* (*manuf.htm*). The NETCANOEM has to be connected to a NetBox to access the System Info.

If possible, the F/T system should be accessible when talking with an ATI Industrial Automation customer service representative.

10.2 Questions and Answers

10.2.1 Powering Up

Question/Problem	Answer/Solution
LED stays red after power up phase	There may be an internal error in the NETCANOEM. Check the status register () for further details.
LED blinks green after power up phase	DIP switch SW2 position 1 is set to the ON position; NETCANOEM operates with default settings.

10.2.2 CAN Bus Communication

Question/Problem	Answer/Solution
LED blinks red	A CAN bus communication error has occurred.
No CAN communication	Make sure that baud rate and base identifier are set correctly. Return NETCAMOEM board to default to verify communication, refer to *Section 5.1—Reset Default Settings*
No or intermittent CAN communication	Make sure that the CAN bus is correctly terminated. Use DIP switch SW2 position 2 to add/remove the on-board termination resistor.

10.2.3 Errors with Force and Torque Readings

Bad data from the transducer's strain gages can cause errors in force/torque readings. These errors can result in problems with transducer biasing and accuracy. Listed below are the basic conditions of bad data. Use this to troubleshoot your problem.

Question/Problem	Answer/Solution
Noise	Jumps in raw strain gage readings (with transducer unloaded) greater than 80 counts is considered abnormal. Noise can be caused by mechanical vibrations and electrical disturbances, possibly from a poor ground. It can also indicate component failure within the system. Make sure that the DC supply voltage for the NETCANOEM has little to no noise superimposed.
Drift	After a load is removed or applied, the raw gage reading does not stabilize, but continues to increase or decrease. This may be observed more easily in resolved data mode using the bias command. Drift is caused by temperature change, mechanical coupling, or internal failure. Mechanical coupling is caused when a physical connection is made between the tool plate and the transducer body (i.e., filings between the tool adapter plate and the transducer body). Some mechanical coupling is common, such as hoses and wires attached to a tool.
Hysteresis	When the transducer is loaded and then unloaded, gage readings do not return quickly and completely to their original readings. Hysteresis is caused by mechanical coupling (explained in Drift section) or internal failure.

11. Specifications

11.1 Storage and Operating Conditions

Table 10.1**—Temperature**		
Component	**Storage Temperature, °C**	**Operating Temperature, °C**
NETCANOEM	-40 to +100	-20 to +80
9105-MINI45TH12-AE-0.40-MSL	See manual *9620-05-Transducer Section*	See manual *9620-05-Transducer Section*

11.2 Electrical Specifications

Table 10.2**—Power Supply**			
Power Source†	**Minimum Voltage**	**Maximum Voltage**	**Maximum Power Consumption[4]**
DCIN through J1, J2 or P1	12V	25V	2.5W

The NETCANOEM power supply input is protected against wrong polarity.

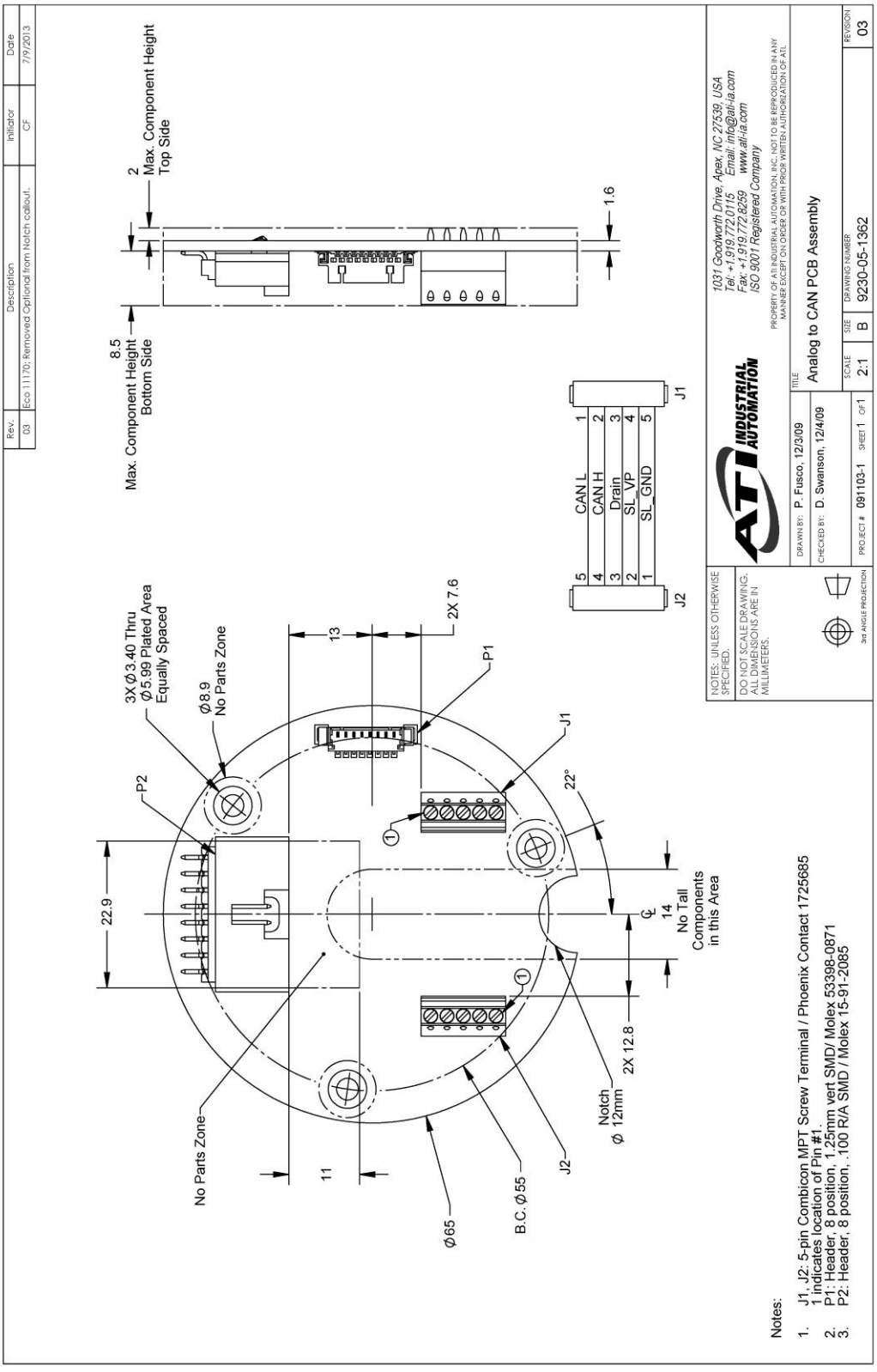
11.3 Weights and Dimensions

Table 10.3**—Weights and Dimensions**		
Component	**Weight (approx.)**	**Dimensions**
NETCANOEM PCB Assembly	22g (0.7oz)	See drawing in Section 12.1
9105-MINI45TH12-AE-0.40-MSL	See manual *9620-05-Transducer Section*	See manual *9620-05-Transducer Section*

[4] With Mini45 transducer connected to the 9010-05-1059 Analog To CAN PCB Assembly

12. Drawings

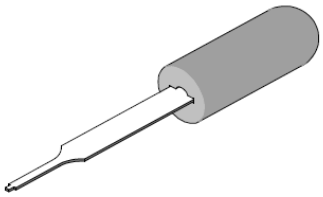
12.1 9010-05-1059 Analog to CAN PCB Assembly



12.2 Insertion and Extractor Tool for Transducer Connector Contacts

Insertion and Extractor Tool

Insertion and Extractor Tool
Instruction Sheet
Order No. 11-02-0022
(HTA60615)



FEATURES

- This tool is designed to insert series 70021, 70028, 70058, 70110, and 71851 terminals into crimp housings (Series 70066 and 70107)
- This tool is designed to extract series 91821 terminals from crimp housings (Series 91935)

SCOPE

Products: 2.54mm (.100") Pitch SL™ and Picoflex® Discrete Wire Crimp Terminals.

Terminal Series No.	Terminal Order No.							
70021	16-02-0077	16-02-0078	16-02-0079	16-02-0080	16-02-0081	16-02-0091	16-02-0092	16-02-0093
	16-02-0105	16-02-0106	16-02-0107	16-02-0108	16-02-0109	16-02-0110	16-02-0111	16-02-0112
	16-02-0113	16-02-0114	16-02-0115	16-02-0116	16-02-0117	70021-0081	70021-0114	70021-0117
	40-08-0871	40-08-0872	40-08-0873	40-08-0874				
70028	40-08-4832	40-08-4833	40-08-4834	40-08-4860	40-12-4831	40-12-4832	40-12-4833	40-12-4834
	40-12-4835	40-12-4836	40-12-4943	40-12-4944	70028-0005			
70058	16-02-0069	16-02-0074	16-02-0082	16-02-0083	16-02-0084	16-02-0085	16-02-0086	16-02-0087
	16-02-0088	16-02-0096	16-02-0097	16-02-0098	16-02-0099	16-02-0100	16-02-0101	16-02-0102
	16-02-0103	16-02-0104	16-02-0131	16-02-0135	16-02-0137	16-02-0139	16-02-0140	16-02-0143
	16-02-0144	16-02-0147	16-02-0150	16-02-0151	16-02-0152			
	70058-0069	70058-0082	70058-0083	70058-0084	70058-0086	70058-0087	70058-0088	70058-0096
	70058-0097	70058-0099	70058-0102	70058-0103	70058-0104	70058-4069	70058-4084	70058-4086
	70058-4096	70058-4099	70058-4102	70058-5001				
70110	40-07-4826	40-07-4827	40-07-4828	40-07-4829	40-08-0827	40-08-4827	40-08-4828	40-08-4829
	40-08-4877	40-08-4878	40-12-4827	40-12-4828	40-12-4829	40-12-4847	40-12-4848	40-12-4849
	40-12-4907	40-12-4908						
71851	16-02-0119	16-02-1109	16-02-1110	16-02-1111	16-02-1112	16-02-1113	16-02-1114	16-02-1115
	16-02-1116	16-02-1117	16-02-1118	16-02-1119	16-02-1120	16-02-1121	16-02-1122	16-02-1123
	16-02-1124	16-02-1125						
	71851-0119	71851-1110	71851-1112	71851-1114	71851-1115	71851-1116	71851-1118	71851-1119
	71851-4110	71851-4112	71851-4114	71851-4116	71851-4118	71851-4119	71851-8022	
91821	91821-0001	91821-0003						

Doc No: ATS-011020022 Release Date: 07-25-02 **UNCONTROLLED COPY** Page 1 of 2
Revision: K Revision Date: 05-26-09

Insertion and Extractor Tool

OPERATION:

For Insertion of 70021, 70028, 70058, 70110, and 71851 Terminal Series:

Individual terminals may be inserted in the housing using this Insertion tool.

1. To properly use this tool, with the flat side facing up, place the step of the tool into the terminal under the locking tangs (See Figure 1). Push the terminal into the housing until the locking tangs are visible through the window. The terminal then should be locked in place.

Optional: The terminal can be partially inserted in the terminal housing first, and then the Insertion tool can be used to firmly seat the terminal.

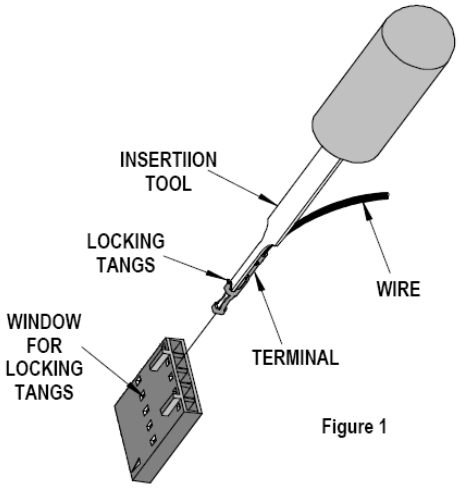


Figure 1

Note: Please do not forcefully insert, insert on an angle, or insert with twisting action. It may damage the tool or the housing.

For Extraction of 91821 Terminal Series:

Individual terminals may be extracted from the housing using this Tool.

1. Push the terminal and the wire forward in the arrow direction before using this Tool. Insert the Tool into the slot above the locking tang of the terminal. Push the tool down until the locking tang is even with the rest of the terminal. This will free the terminal from the housing.
2. Holding the wire and the tool together, pull the wire back through the connector slot in the arrow direction as shown in Figure 2.

Molex does not offer repair parts for this Tools due to the inexpensive nature of the tool

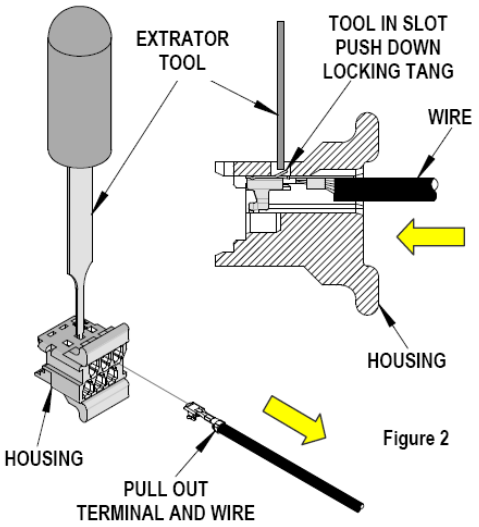


Figure 2

Americas Headquarters
Lisle, Illinois 60532 U.S.A.
1-800-78MOLEX
amerinfo@molex.com

Far East North Headquarters
Yamato, Kanagawa, Japan
81-462-65-2324
feninfo@molex.com

Far East South Headquarters
Jurong, Singapore
65-6-268-6868
fesinfo@molex.com

European Headquarters
Munich, Germany
49-89-413092-0
eurinfo@molex.com

Corporate Headquarters
2222 Wellington Ct.
Lisle, IL 60532 U.S.A.
630-969-4550
Fax: 630-969-1352

Visit our Web site at http://www.molex.com

13. Terms and Conditions of Sale

The following Terms and Conditions are a supplement to and include a portion of ATI's Standard Terms and Conditions, which are on file at ATI and available upon request.

ATI warrants to Purchaser that force torque sensor products purchased hereunder will be free from defects in material and workmanship under normal use for a period of one year from the date of shipment. This warranty does not cover components subject to wear and tear under normal usage or those requiring periodic replacement. ATI will have no liability under this warranty unless: (a) ATI is given written notice of the claimed defect and a description thereof with thirty (30) days after Purchaser discovers the defect and in any event, not later than the last day of the warranty period and (b) the defective item is received by ATI not later than (10) days after the last day of the warranty period. ATI's entire liability and Purchaser's sole remedy under this warranty is limited to repair or replacement, at ATI's election, of the defective part or item or, at ATI's election, refund of the price paid for the item. The foregoing warranty does not apply to any defect or failure resulting from improper installation, operation, maintenance, or repair by anyone other than ATI.

ATI will in no event be liable for incidental, consequential, or special damages of any kind, even if TI has been advised of the possibility of such damages. ATI's aggregate liability will in no event exceed the amount paid by the purchaser for the item which is the subject of claim or dispute. ATI will have no liability of any kind for failure of any equipment or other items not supplied by ATI.

No action against ATI, regardless of form, arising out of or in any way connected with products or services supplied hereunder, may be brought more than one year after the cause of action accrued.

No representation or agreement varying or extending the warranty and limitation of remedy provisions contained herein is authorized by ATI, and may not be relied upon as having been authorized by ATI, unless in writing and signed by an executive officer of ATI.

Unless otherwise agreed in writing by ATI, all designs, drawings, data, inventions, software, and other technology made or developed by ATI in the course of providing products and services hereunder, and all rights therein under any patent, copyright, or other law protecting intellectual property, shall be and remain ATI's property. The sale of products or services hereunder does not convey any expressed or implied license under any patent, copyright, or other intellectual property right owned or controlled by ATI, whether relating to the products sold or any other matter, except for the license expressly granted below.

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Without ATI's prior written permission, Purchaser will not use such information for any other purpose of provide or otherwise make such information available to any third party. Purchaser agrees to take all reasonable precautions to prevent any unauthorized use or disclosure of such information.

Purchaser will not be liable hereunder with respect to disclosure or use of information which: (a) is in the public domain when received from ATI, (b) is thereafter published or otherwise enters the public domain through no fault of Purchaser, (c) is in Purchaser's possession prior to receipt from ATI, (d) is lawfully obtained by Purchaser from a third party entitled to disclose it, or (f) is required to be disclosed by judicial order or other governmental authority, provided that, with respect to such to maintain the confidentiality of such information.